Structured Problem Solving

ENGI/LEAD 545– Spring 2014

Tuesday 1-4pm, BRC284

Objectives

This course shows how to structure the resolution of complex, ill-defined, non-immediate (CIDNI) problems. It is project based, so each student brings a problem that becomes their project for the course and a case study for the group. The students apply the concepts covered in the course to their problem, structuring its resolution as the course advances, and presenting their progress to the class for continuous feedback.

By contributing a case study, each student helps their classmates move away from the technicalities of their discipline to focus on transferrable skills—logic, innovation, rigorous formulation of hypotheses, clarity of thinking, etc.—that allows them to develop an ability to think strategically. It is an objective of the course that students learn how to leverage these transferrable skills to approach problems in fields they know little about.

As such, the class composition is highly diverse, which has three major purposes:

- Facilitating system thinking by integrating problems in their larger contexts,
- Fostering the group's creativity by approaching problems from radically different points of view and
- Emulating work in "real" organizations, where one must interact with people with different profiles.

In addition the course emphasizes the value of a highly analytical approach, where evidence-based decision making is key.

Another objective of the course is for students to be able to explain their project to students who are not subject matter experts. This usually requires the presenter to reinforce their understanding of the problem, gaining insight into its underlying structure.

Finally, a pivotal objective of the class is learning to leverage the collective skill set of the class and contributing to it. As such, a high involvement in the class dynamic is essential.

Instructor

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Learning outcomes

By the end of the course, students will be able to:

1. **Frame the problem.** Students will learn how to single out *the* real problem in a given situation,

ensuring they are not focusing on just a symptom or a less critical problem. Students will also learn to identify key stakeholders and decision makers, project parameters, and elements out of scope. Finally, they will learn to summarize this information in a problem identification card.

2. **Diagnose the problem.** Students will learn how to identify the root causes of the problem by building a diagnostic issue map. They will learn how to structure the map, associate hypotheses which each branch, design the analysis to test the hypotheses, identify the data needed to fuel the analysis, gather that data, test the hypotheses, and conclude. They will also learn how to structure their thinking in mutually exclusive and collectively exhaustive components and rank the comparative insightfulness of competing frameworks.
3. **Identify solutions.** Students will learn how to transition from the diagnostic to the active search for a solution by building a solution issue map. They will learn how to structure the solution map—understanding key similarities and differences with diagnostic issue maps—develop hypotheses, design the analysis to test them, and test them. Students will also learn about decision making: how to pick the best solution, using decision matrices or other decision-making tools.
4. **Execute the solution.** Students will learn how to use logic to communicate better—through a PowerPoint/Keynote presentation. Time permitting, we will also talk about the other two components of Aristotelian persuasion (reputation and emotions) as well as basic concepts of project management and team leadership—two essential components of solution implementation—as well as the continuous evaluation of the solution's performance once implemented.

Key characteristics

You will spend a lot of time on your project, so choose one that has a lot of value to you. A popular choice with previous students is to work on your thesis.

Each session is a mix of theory and case studies, with an emphasis on the practical part. You will integrate the theory in your project and present it periodically to the class for discussion.

Class participation is key, as reflected in the grading structure. You are all expected to contribute to discussions and help your classmates improve their projects—especially those in disciplines different than your own. A significant part of the grade depends on how much you help others.

The reading material is due *before* the corresponding lecture. We'll use 'Structured Problem Solving-Manuscript' (available on OwlSpace) and other resources. To help you extract the relevant 'so what?' for you, at the beginning of each class, you will hand in a one-page summary of the reading addressing: -1- Your main take away and -2- Your reflection on how are you going to modify your current practice to include what you've learned. This counts as part of the 'participation in class' grade.

We'll spend most time in class reviewing the progress that you are making. We'll do so either altogether or in smaller groups. So your classmates will become your primary support. As such, the more they learn about your problem, the more it helps you.

Please seek the input of your classmates. Do it often and do it with different classmates. As a general rule, you should first seek the feedback of at least one of your classmates before asking for my input in office hours.

Please realize that your ability to get up to speed on a colleague's project—including one in which you

know nothing about—is an essential leadership skill in the work place. So by helping your classmates with their projects, you are developing this fundamental skill. You are also fishing for new ideas: after each interaction, take a moment and ask yourself how what you discussed might be applicable to your problem.

When handing in a deliverable, please submit a printout in class at the beginning of the session in which it is due and upload it in the specific file format identified for the task on your drop box in OwlSpace.

At least five students must be enrolled for the course to be offered. The course has no prerequisites. It's worth three semester hours.

Course calendar

	Date	Topic	Reading	Deliverable
1	1/14	Course overview Develop the project charter	Syllabus	
2	1/21	Frame the diagnostic problem	Chevallier: intro, chapters 1, 2, 3 (Savransky 2002) chapter 1	Take away from reading
3	1/28	Develop a diagnostic issue map	(Twardy 2010)	Take away from reading Project template
4	2/4	Develop a diagnostic issue map	(Platt 1964)	Take away from reading Diagnostic definition card
5	2/11	Design a diagnostic analysis Conduct a diagnostic analysis	(King 2010) Chapter 4	Take away from reading Diagnostic issue map
6	2/18	Conduct a diagnostic analysis	(Nickerson 1998)	
7	2/25	Prepare a report for diagnostic analysis	Chapter 5	
	3/4	Spring break – no class		
8	3/11	Present your report of diagnostic analysis		Report of diagnostic analysis
9	3/18	Frame the solution problem	Chapter 8	
10	3/25	Develop a solution issue map		Solution definition card
11	4/1	Design a solution analysis	Chapter 6	

	Date	Topic	Reading	Deliverable
12	4/8	Conduct the solution analysis	Chapter 7	Solution issue map
13	4/15	Conduct the solution analysis		
14	4/22	Present your report for solution analysis		Report of solution analysis

Additional reading

(Singer, Nielsen et al. 2012); (Polya 2008); (Minto 2009); Powerful-problem-solving.com; Timvangelder.com; (Jones 1998); (Higgins 1994); (Ohmae 1982); (De Bono 1992); (Zelazny 2004); (Zelazny 1996)

Course grading

	Value towards final grade
Class participation, including contributions to help others and comments on reading assignments	35%
Project template	5%
Problem identification card	5%
Diagnostic map	10%
Report of diagnostic analysis	10%
Solution definition card	5%
Solution map	10%
Solution hypotheses, analysis, and conclusions	10%
Final presentation and implementation plan	10%
Total	**100%**

I'll use a numeric scale during the semester before converting to a letter scale using the following correspondance:

Grade	**Minimum percent**
A	90
B	80
C	70
D	60

F	0

Assignments turned in late receive a 1% penalty per late day.

Academic honor code

Students are responsible for maintaining the integrity of academic work at Rice. All students must comply with the honor code and state so on each deliverable they hand in.

You can learn more about the Honor System at http://honor.rice.edu/

Disabilities

Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain confidential. Students with disabilities will need to also contact Disability Support Services on the first floor of Allen Center (x5841 / adarice@rice.edu).

Others

If you have a laptop or a tablet, bring it to class as it is easier to draw issue maps on those. If this is not possible, bring your latest progress on a USB key or a similar device and arrange with a classmate to be able to project from their computer.

Consider acquiring a mapping software to develop issue maps. A review of common packages is available here.

This syllabus reflects as closely as possible the course as it unfolds over each session. However deliverables might change. Therefore don't trust it blindly for due dates and lecture plans. Instead, ensure that you comply with assignments discussed in class. If you miss a class, it is your responsibility to check on assignments due and hand them in time.

You are expected to come to class and participate actively. If you can't make it to a session, please inform me ahead of time. If you miss a session, ensure that you catch up on the material covered—and the assignments—on time.

The class models typical interactions in the workplace. Therefore please display a professional attitude; in particular be proactive and responsive.

Office hours

Thursdays 1 to 2pm in Allen Center 323G or by appointment (email me).

Bibliography

De Bono, E. (1992). Serious creativity: Using the power of lateral thinking to create new ideas. New York, Harper Business.

Higgins, J. M. (1994). 101 creative problem solving techniques: The handbook of new ideas for business, New Management Publishing Company Florida.

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Nickerson, R. S. (1998). "Confirmation bias: a ubiquitous phenomenon in many guises." Review of General Psychology 2(2): 175.

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Platt, J. R. (1964). "Strong inference." science 146(3642): 347-353.

Polya, G. (2008). How to solve it: A new aspect of mathematical method, Princeton University Press.

Savransky, S. D. (2002). Engineering of creativity: Introduction to TRIZ methodology of inventive problem solving, CRC Press.

Singer, S. R., N. R. Nielsen and H. A. Schweingruber (2012). Discipline-based education research: Understanding and improving learning in undergraduate science and engineering, National Academies Press.

Twardy, C. (2010). "Argument maps improve critical thinking." Teaching Philosophy 27(2): 95-116.

Zelazny, G. (1996). Say it with charts, McGraw-Hill.

Zelazny, G. (2004). Say it with Presentations, Tata McGraw-Hill Education.